PORTLAND HARBOR RI/FS

APPENDIX A
SEDIMENT DATABASE DESCRIPTION
DRAFT FINAL FEASIBILITY STUDY

DRAFT

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LIST OF ACRONYMS

2,3,7,8-TCDD	Tetrachlorodibenzo-p-dioxin
BAP	Benzo(a)pyrene
BaPEq	Benzo(a)pyrene Equivalent
BERA	Baseline Ecological Risk Assessment
BHHRA	Baseline Human Health Risk Assessment
BRA	Baseline Risk Assessment
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CASRN	Chemical Abstracts Service Registry Number
cm	centimeter
cPAH	carcinogenic Polycyclic Aromatic Hydrocarbon
DDD	Dichloro-diphenyl-dichloroethane
DDE	Dichloro-diphenyl-dichloroethene
DDT	Dichloro-diphenyl-trichloroethane
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
HPAH	High-molecular-weight Polycyclic Aromatic Hydrocarbon
LPAH	Low-molecular-weight Polycyclic Aromatic Hydrocarbon
LWG	Lower Willamette Group
NAVD88	North American Vertical Datum of 1988
OC	Organic Carbon
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCDD/F	Dibenzo-p-dioxin/furan
PEFs	Potency Equivalent Factors
PRGs	Preliminary Remediation Goals
RI	Remedial Investigation
RM	River Mile
SCRA	Site Characterization and Risk Assessment
SDU	Sediment Decision Unit
SMA	Sediment Management Area
TEF	Toxic Equivalency Factors
TEQ	Toxic Equivalent
TOC	Total Organic Carbon
TZW	Transition Zone Water
VOC	Volatile Organic Compound
WHO	World Health Organization

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A1. INTRODUCTION

This appendix describes the Feasibility Study (FS) sediment database used in the alternatives development and evaluations in the FS. The source of the data is the Site Characterization and Risk Assessment (SCRA) database used for evaluations in the Remedial Investigation (RI) Report (RI citation). For the RI and FS, a date of May 1, 1997, was used to define the initiation of the sediment dataset to follow the last major flood of the lower Willamette River in the winter of 1996. The SCRA database includes data collected through July 19, 2010. However, additional data was added to the FS database after this date and includes the following:

- Additional updates to the SCRA database posted to the Lower Willamette Group's (LWG) portal through February 4, 2011
- Gasco Engineering Evaluation/Cost Analysis (EE/CA) data as provided by Anchor QEA in 2013 and meeting the FS sediment database protocols described herein
- Arkema EE/CA data as provided by Integral in May 2014 and meeting the FS sediment database protocols described herein

The FS database only includes sediment data and does not contain porewater, surface water, TZW, or biota/tissue data; those data are retained in the SCRA database although they may be used for analysis in the FS. Data handling rules for the SCRA database are described in *Guidelines for Data Averaging and Treatment of Non-detected Values for Round 1 Database* (Kennedy/Jenks et al. 2004).

Data selection criteria for the FS sediment database follow Portland Harbor RI dataset rules (RI citation). However, the SCRA database did not use consistent summing rules as were used in the baseline risk assessment (BRA). To allow for evaluations of risk reduction based on various alternatives presented in the FS, it was necessary to ensure that the data were treated in a manner consistent with the BRA. Data selection, evaluation, summation rules, and other rules and procedures for the FS sediment database are described in the following sections.

A2. DATA SELECTION

As discussed in the RI (RI citation), environmental data have been collected within the Portland Harbor Site during numerous LWG sampling events and from other historical and concurrent studies and constitute the Portland Harbor SCRA database. The data lockdown date for the SCRA database was July 19, 2010. The Portland Harbor SCRA database was used to prepare the RI and risk assessments. The RI, baseline ecological risk assessment (BERA), and baseline human health risk assessment (BHHRA) database managers separately queried the SCRA database to derive subsets of data to support their respective efforts, as described in the RI.

The FS sediment database was derived from the SCRA database and the dataset is identical to the RI dataset except for the following additions identified in Section 1: additional updates to the SCRA database posted to the LWG's portal through February 4, 2011, Gasco EE/CA data set, and Arkema EE/CA data set. The FS sediment database was compiled using the following guidelines:

- Includes data collected on or after May 1, 1997. Includes only samples with a sediment matrix (sample matrix code "SE"); this does not include sediment trap data.
- Includes only data from locations with an elevation of less than or equal to 13 feet North American Vertical Datum of 1988 (NAVD88).
- Excludes sample results from locations that have been subject to early action, marked as "dredged" or "capped."
- Per RI data selection rules, includes data that had a quality assurance approval code indicating a Category 1-level of data quality and either a level of validation of "QA1" or "QA2".
- Includes sample results from locations with river mile (RM) designations ranging from 0 to 26.1, as well as from Multnomah Channel locations (RM "-99"). The Site extends from RM 1.9 through RM 11.8.

A2.1 DEPTH CATEGORIZATION

Depths for sediment data have been categorized as follows: surface sediments are defined as samples with a start depth of 0 and end depth of less than or equal to 40 centimeters (cm). All other samples are considered to be subsurface sediments.

A2.2 SPATIAL CATEGORIZATION

This version of the database does not contain information regarding the Sediment Decision Unit (SDU) or sediment management area (SMA) associated with a given location. The user must generate these relationships through GIS-based spatial analysis.

A2.3 ANALYTE NOMENCLATURE

Analytes are distinguished by their Chemical Abstracts Service registry number (CASRN) or by their analyte name. Where an analyte may have two or more synonyms, the LWG Nature and Extent nomenclature has been retained. In the case of calculated analyte group totals where a CASRN is not available, a project-specific CASRN has been assigned.

As will be further defined in the following sections, analyte group totals were calculated for the analyte groups used for the preliminary remediation goals (PRGs), which are the basis for remedial design. In addition, some parameters were normalized by organic carbon (OC), as further defined in Section 3.

A3. NORMALIZATION BY ORGANIC CARBON

When calculating OC-normalized results, a value of 0.2 percent was used whenever the reported total organic carbon (TOC) result was less than 0.2 percent or if the TOC result was non-detect. If a sediment sample did not have a reported TOC result, a value of 1 percent was assumed. The final result was rounded to the minimum number of significant figures among the source analyte results. In the case of an assumed TOC value, two significant figures were assumed.

A4. CALCULATION OF ANALYTE TOTALS

A4.1 INTRODUCTION

Calculation of analyte group totals follows the BRA rules defined in the RI (RI citation). The procedures are summarized as follows:

- Calculated totals are the sum of all detected results and non-detected results at one half the reporting detection limit for analytes detected at least once in the risk assessment dataset within the Site for a given medium.
- If none of the analytes are detected for a given sample, but are determined to be present within the Site, then the highest detection limit is used for the summation.
- Analytes never detected within a dataset for a given medium are excluded from totals.

The following analyte totals are provided in the database, under the Chemical_Name and CAS_RN columns as shown in Table 1.

Table A-1. Analyte Nomenclature for Analyte Totals Contained in the Feasibility Study Sediment Database

Analyte Group	Description	Chemical_Name	CAS_RN
Pesticides	Total 2,4-DDx	LWG RA Sum 2,4 DDT, DDE, DDD (Calculated U = 1/2)	LRASum_DDT2_N
Pesticides	Total 4,4-DDx	LWG RA Sum 4,4 DDT, DDE, DDD (Calculated U = 1/2)	LRASum_DDT4_N
Pesticides	Total DDD	LWG RA Sum DDD (Calculated U = 1/2)	LRASum_DDD_N
Pesticides	Total DDE	LWG RA Sum DDE (Calculated U = 1/2)	LRASum_DDE_N
Pesticides	Total DDT	LWG RA Sum DDT (Calculated U = 1/2)	LRASum_DDT_N
Pesticides	Total DDx	LWG RA Total DDx (Calculated U = 1/2)	LRAtDDT_N
Pesticides	Total Chlordane	LWG RA Total Chlordane (Calculated U = 1/2)	LRAtChlordan_N
Pesticides	Total Endosulfan	LWG RA Total Endosulfan (Calculated U = 1/2)	LRAtENDOSLF_N
PAHs	Total LPAH	LWG RA Total 7 of 17 LPAH (Calculated U = 1/2)	LRAtPAH_17_LM_N
PAHs	Total HPAH	LWG RA Total 10 of 17 HPAH (Calculated U = 1/2)	LRAtPAH_17_HM_N
PAHs	Total PAH	LWG RA Total 17 PAH (Calculated U = 1/2)	LRAtPAH_17_N
PAHs	Total cPAH (BaPeq)	LWG RA Total cPAH TEQ (EPA 1993) (Calculated U = 1/2)	LRAtcPAHTEF7_N
VOCs	Total Benzo(x)fluoranthenes	LWG RA Total Benzo(x)fluoranthenes (Calculated U = 1/2)	LRAtBF_N

Analyte Group	Description	Chemical_Name	CAS_RN
VOCs	BTEX	LWG RA Total BTEX (Calculated U = 1/2)	LRAtBTEX_N
VOCs	Total Xylene	LWG RA Total Xylene (Calculated U = 1/2)	LRAtXylene_N
PCB_Homologs	Mono-CB	LWG RA Total Monochlorobiphenyl homologs (Calculated U = 1/2)	LRASum_MonPCB_N
PCB_Homologs	Dichloro-CB	LWG RA Total Dichlorobiphenyl homologs (Calculated U = 1/2)	LRASum_DiPCB_N
PCB_Homologs	Tri-CB	LWG RA Total Trichlorobiphenyl homologs (Calculated U = 1/2)	LRASum_TriPCB_N
PCB_Homologs	Tetra-CB	LWG RA Total Tetrachlorobiphenyl homologs (Calculated U = 1/2)	LRASum_TetPCB_N
PCB_Homologs	Penta-CB	LWG RA Total Pentachlorobiphenyl homologs (Calculated U = 1/2)	LRASum_PenPCB_N
PCB_Homologs	Hexa-CB	LWG RA Total Hexachlorobiphenyl homologs (Calculated U = 1/2)	LRASum_HexPCB_N
PCB_Homologs	Hepta-CB	LWG RA Total Heptachlorobiphenyl homologs (Calculated U = 1/2)	LRASum_HepPCB_N
PCB_Homologs	Octa-CB	LWG RA Total Octachlorobiphenyl homologs (Calculated U = 1/2)	LRASum_OctPCB_N
PCB_Homologs	Nona-CB	LWG RA Total Nonachlorobiphenyl homologs (Calculated U = 1/2)	LRASum_DecPCB_N
PCB_Homologs	Deca-CB	LWG RA Total Decachlorobiphenyl homologs (Calculated U = 1/2)	LRASum_NonPCB_N
Total PCBs	Total PCB Aroclors	LWG RA Total PCB Aroclors (Calculated U = 1/2)	LRAtPCB_N
Total PCBs	Total PCB Congeners	LWG RA Total PCB Congener (Calculated U = 1/2)	LRAtPCBCong_N
Dioxins_Furans	Total Dioxins/Furans	LWG RA Total PCDD/F (Calculated U = 1/2)	LRAtPCDDF_N
Dioxin TEQ	Dioxin TEQ-Avian	LWG RA Total Dioxin/Furan TEQ 1998 (Avian) (Calculated U = 1/2)	LRAtDioxFurB_N
Dioxin TEQ	Dioxin TEQ-Fish	LWG RA Total Dioxin/Furan TEQ 1998 (Fish) (Calculated U = 1/2)	LRAtDioxFurF_N
Dioxin TEQ	Dioxin TEQ-Mammalian	LWG RA Total Dioxin/Furan TEQ 2005 (Mammal) (Calculated U = 1/2)	LRAtDioxFurM_N
Dioxin TEQ	PCB TEQ-Avian	LWG RA Total PCB Congener TEQ 1998 (Avian) (Calculated U = 1/2)	LRAtPCBCngB98_N
Dioxin TEQ	PCB TEQ-Fish	LWG RA Total PCB Congener TEQ 1998 (Fish) (Calculated U = 1/2)	LRAtPCBCngF98_N
Dioxin TEQ	PCB TEQ-Mammalian	LWG RA Total PCB Congener TEQ 2005 (Mammal) (Calculated U = 1/2)	LRAtPCBCngCPM_N

Notes:
BTEX = benzene, toluene, ethylbenzene, and total xylene
HPAH = high molecular weight PAH
LPAH = low molecular weight PAH
LWG = Lower Willamette Group
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RA = Risk Assessment
TEQ = toxic equivalent
VOC = volatile organic compound

Individual analytes included in totals are as described in Sections 4.1.1 through 4.1.9.

PCB Totals

Total polychlorinated biphenyls (PCBs) were calculated either from the sum of individual congeners, when congener-based results were available, or as the sum of Aroclors. For samples with both Aroclor-based and congener-based results, totals were derived from congener values. There were two exceptions to this rule:

1. Task B01-01-48B_BK samples were summed based on Aroclor results, because only the dioxin-like congeners were reported
2. Task WLCOFJ02 samples had too few (15) congeners reported

Aroclor-based totals summed all reported Aroclors and assumed one half the detection limit as the result for non-detected Aroclors. The chemical name and project-specific CASRN distinguish whether the total was based on congeners or Aroclors. In the FS sediment database, only one PCB total (either Aroclor- or congener-based) exists for each sample.

PCB homolog totals were calculated consistent with risk assessment summing rules as the sum of individual PCB congeners in a homolog group. In the FS dataset, all reported co-eluting congeners are constituents of the same homolog and did not affect multiple homolog groups. For completeness, decachlorobiphenyl, a single congener (209), is reported as both its individual analyte result and as a homolog total.

Total PCDD/Fs

Total polychlorinated dibenzo-p-dioxin/furan (PCDD/Fs) were calculated as the sum of individual PCDD/F compounds, which is consistent with BERA summing rules. The BHHRA relies solely on tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) toxic equivalent.

PCB and Dioxin TEQs

Toxic equivalency factors (TEFs) were used to calculate PCB and dioxin TEQs. Concentrations of relevant congeners are multiplied by their TEFs to estimate toxicity of the congeners relative to 2,3,7,8-TCDD. Resulting concentrations are summed. TEFs are published by the World Health Organization (WHO) for fish and birds (Van den Berg et al. 1998) and for mammals (Van den Berg et al. 2006).

DDx Totals

Total DDx was calculated as the sum of the six DDx compounds: 2,4′-dichloro-diphenyl-dichloroethane (DDD); 4,4′-DDD; 2,4′-dichloro-diphenyl-dichloroethene (DDE); 4,4′-DDE; 2,4′-dichloro-diphenyl-trichloroethane (DDT); and 4,4′-DDT.

Total DDD was calculated as the sum of 2,4′-DDD and 4,4′-DDD results.

Total DDE was calculated as the sum of 2,4′-DDE and 4,4′-DDE results.

Total DDT was calculated as the sum of 2,4′-DDT and 4,4′-DDT results.

PAH Totals

Total low molecular weight polycyclic aromatic hydrocarbons (LPAH) is the sum of 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene.

Total high molecular weight polycyclic aromatic hydrocarbons (HPAH) is the sum of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzofluoranthene, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

Total polycyclic aromatic hydrocarbons (PAH) is the sum of the individual LPAHs and HPAHs.

Total carcinogenic PAH (cPAH) is the sum of benzo(a)pyrene (BaP) equivalent (BaPEq) concentrations, calculated by multiplying the cPAHs by their respective potency equivalent factors (PEFs). Carcinogenic PAHs include benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, and dibenzo(a,h)anthracene. PEFs were assigned according to EPA (1993).

Total Chlordane

Total chlordane is the sum of cis-chlordane, trans-chlordane, oxychlordane, cis-nonachlor, and trans-nonachlor.

Total Endosulfan

Total endosulfan is the sum of alpha-endosulfan, beta-endosulfan, and endosulfan sulfate.

Total Xylene

Total xylene is the sum of m,p-xylene and o-xylene.

BTEX

BTEX is the sum of benzene, toluene, ethylbenzene, and total xylene.

A4.2 REPORTABLE ANALYTE REQUIREMENTS FOR TOTALS

The expected number of analytes for certain totals is shown in Table 2. If the number of analytes reported is limited, the total was given an “A” qualifier. Some totals had a minimum number of reportable analytes, below which totals were not calculated.

Table A-2. Result Requirements for Generating Analyte Totals

Chemical Name	Expected Analytes	'A' qualify (Limited)	Do Not Sum
Total PCBs Aroclors	7 or 9	<7	<2
Total PCDD/Fs	17	<17	<10
Total HPAHs	10	<10	<5
Total LPAHs	7	<7	<3
Total PAHs	17	<17	<10
Total PCB Congeners	209	<150	<100
Sum DDD	2	<2	
Sum DDE	2	<2	
Sum DDT	2	<2	
Total DDx	6	<6	
Total Chlordane	5	<5	
Total Endosulfan	3	<3	
Total Xylenes	2	<2	

A5. DEFINITION AND PROPAGATION OF QUALIFIERS

As in the SCRA database (RI citation), the following qualifier definitions were used in this database:

Table A-3. Analytical Chemistry Qualifier Definitions

Qualifier	Description
A	Summed value based on limited number of analytes.
J	Estimated value.
JA	Combined qualifier.
JT	Combined qualifier.
N	Presumptive evidence of a compound.
NJ	Combined qualifier.
NJT	Combined qualifier.
NT	Combined qualifier.
R	Rejected.
T	Result calculated or selected from >1 reported value.
U	Analyte was analyzed for but not detected.
UA	Combined qualifier.
UJ	Not detected. Sample detection limit is estimated.
UJA	Combined qualifier.
UJT	Combined qualifier.
UT	Combined qualifier.

Additionally, as further discussed in the RI (RI citation), the N-qualifier denotes that the identity of the analyte is presumptive and not definitive, generally as a result of the presence in the sample of an analytical interference, such as hydrocarbons or, in the case of pesticides, PCBs.

In cases where average concentrations are derived from results of replicates and splits, or where analyte group totals were calculated, validation qualifiers were propagated as follows:

- J or N qualifiers used for any individual analyte used to calculate an analyte group total were retained for qualifying the analyte group total.
- If one or more of the results were qualified as undetected and one or more of the other results included in a calculated analyte group total were detected and qualified as estimated, the calculated value was qualified as estimated.
- If all of the included results were detected and one or more of the results were qualified as estimated, the calculated value was qualified as estimated.
- The “Detect” field was populated with a Y for detected values and an N for non-detects for all sample results and calculated values.

- Rejected values were not used in averages or totals.
- A T qualifier was added to all results that were calculated (e.g., totals and averages of multiple results) and all results that are selected for reporting in preference to other available results (e.g., for parameters reported by multiple methods).

A6. SIGNIFICANT FIGURES

The reporting to significant figures was handled as discussed in the RI (RI citation). Analytical results provided by laboratories were maintained in the database as text values, in the format received from the reporting laboratories, so that the number of significant figures provided by the labs would not be lost by either the addition or removal of trailing zeros. For example, if the lab file contained 1.0, then that text string would be maintained to avoid conversion to either 1.00 or 1. In some cases, the lab-reported value appeared to have only one significant figure (1, for example). But a minimum of two significant figures was assumed for all results, which was consistent with the standard reporting requirements of analytical laboratories.

During calculations, such as averaging replicates or summing for totals, all significant figures were carried through the calculation. The final result was then rounded to the smallest number of significant figures found in the values used in the calculation. For example: 7010 + 105 + 20.8 = 7135.8, and with three significant figures equals 7140.

A7. CHANGE LOG

The FS database was originally distributed on May 27, 2010.

The FS database was updated, per June 16, 2010 version, to correct a discrepancy in the totaling of benzo-fluoranthenes (PAH group).

Additional SCRA data was added from September 9, 2009, to February 4, 2011.

Change log updates through February 3, 2011 13:11 were included.

The FS database includes surface and subsurface sediment data collected at the Gasco/Siltronic and Arkema early action sites through April 2011.

A8. REFERENCES

EPA. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/600/R-93/089. U.S. Environmental Protection Agency, Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH.

Add RI Report citation

Kennedy/Jenks (Kennedy/Jenks Consultants), Integral Consulting Inc., and Windward Environmental. 2004. Portland Harbor RI/FS Technical Memorandum: Guidelines for Data Reporting, Data Averaging, and Treatment of Nondetected Values for Round 1 Database. In: Round 1 Site Characterization Data Report (Appendix A). Prepared for the Lower Willamette Group, Portland, OR. Kennedy/Jenks Consultants, Portland, OR.

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